PREFORM ASSEMBLY, CONTAINER ASSEMBLY, AND METHOD OF MANUFACTURE

The present invention is directed to preform assemblies for blow molding plastic container assemblies, to plastic container assemblies blow molded from such preform assemblies, and to methods of making such preform assemblies and container assemblies.

Background and Summary of the Invention

In the manufacture of plastic containers, it is conventional to injection mold or compression mold a container preform having a body and a neck finish with one or more external threads or other closure attachment means. The preform neck finish typically is molded to its final geometry, while the body of the preform subsequently is blow molded to the desired geometry of the container body. The preform may be of monolayer construction, or may be of multilayer construction in which one or more intermediate layers in the preform body may or may not extend into the neck finish of the preform. U.S. Patents 4,609,516, 4,710,118 and 4,954,376 illustrate injection molding of multilayer container preforms.

Molding the neck finish portion of a container as part of the container preform presents a number of problems. For example, when the preforms are formed by injection molding, the plastic material typically is injected into a mold cavity at the closed end of the preform body, so that the material must flow along the sides of the preform mold cavity into the area in which the neck finish is molded. The neck finish typically requires more accurate and stable dimensioning than the body of the preform, which can limit the cycle time of the preform molding process. Furthermore,

the neck finish of the preform is of the same material as a monolayer preform body, and of the same material as at least the outer layers of a multilayer preform body, which limits the ability to obtain the most desirable material characteristics at the neck finish. When the preform is of polyester construction, such as polyethylene terephthalate (PET), the neck finish of the preform can be wholly or partially crystallized to improve the operating characteristics of the neck finish area, particularly in hot-fill container applications. However, the requirement that the neck finish be of the same material as at least the outer layers of a multilayer preform body still limits the design capabilities of preform manufacture.

A method of making a preform assembly in accordance with one aspect of th present invention includes providing a finish ring of plastic construction, placing the finish ring onto a core pin, introducing a preform polymer into a mold cavity that includes the core pin, and compression molding the preform polymer to the finish ring.

In accordance with a second aspect of the present invention, there is provided a preform assembly for blow molding a container assembly, which includes a molded plastic finish ring and a plastic preform compression molded to the finish ring such that a neck portion of the plastic preform radially interengages the finish ring.

In accordance with a third aspect of the invention, there is provided a container assembly blow molded from a preform assembly which is produced from compression molding a preform to a molded plastic finish ring. The container assembly includes the molded plastic finish ring, and a plastic container having a neck portion thereof radially interengaging said finish ring.

Brief Description of the Drawings

The invention, together with additional objects, features, advantages and aspects thereof, will be best understood from the following description, the appended claims and the accompanying drawings, in which:

FIG. 1 illustrates a side elevational view of a preform assembly according to one exemplary embodiment of the present invention;

FIG. 2 illustrates a side elevational view of a container assembly, blow-molded from the preform assembly of FIG. 1, according to another exemplary embodiment of the present invention;

FIG. 3 illustrates a side elevational view of a finish ring for the preform and container assemblies of FIGS. 1 and 2;

FIG. 4 illustrates a top view of the finish ring of FIG. 3;

FIG. 5 illustrates a cross-sectional view of the finish ring of FIG. 3, taken along line 5-5;

FIG. 6A illustrates a compression molding apparatus for use in accordance with an exemplary method of the present invention, wherein the apparatus is shown in an open position in which a charge of preform material is located within a mold cavity and a pre-made finish ring is loaded to a core pin;

FIG. 6B illustrates the compression molding apparatus of FIG. 6A wherein the apparatus is shown in a closed position in which the preform material is compression molded within a portion of the pre-made finish ring;

FIG. 7 illustrates a fragmentary cross-sectional view of a portion of the compression molding apparatus of FIGS. 6A and 6B and a cross-sectional view of the resulting preform assembly, wherein the preform assembly has been retracted and is carried on the compression core pin; and

FIG. 8 illustrates an enlarged cross-sectional view of the preform assembly of FIG. 7, taken from circle 8 thereof.

Detailed Description of Preferred Embodiments

FIG. 1 illustrates a preform assembly 20 in accordance with one presently preferred embodiment of the invention as comprising a preform 22 and a separate finish ring 24 secured thereover. The preform 22 may be injection molded, but is preferably produced by compression molding as will be discussed in greater detail below. The preform 22 is composed of any suitable plastic material such as monolayer polyethylene terephthalate (PET) or the like, or multilayer PET or the like in which matrix layers of PET, for example, alternated with one or more layers of a barrier resin material such as ethylene vinyl alcohol (EVOH), nylon or the like. The finish ring 24 is injection or compression molded or the like, and is composed of any desired material such as PET, post consumer resin (PCR), process regrind (REG), polypropylene (PP), polyethylene (PE), polyethylene napthalate (PEN), or the like. Preferably, however, the finish ring 24 is composed of a material different than that of the preform 22, such as amorphous PET for preform 72 and crystalized PET for finish ring 24. FIG. 2 illustrates a container assembly 120 that is blow molded from the preform assembly 20 of FIG. 1 in accordance with another presently preferred embodiment of the present invention, and includes the finish ring 24 secured to a container 122 in a manner that is in all significant respects identical to that of the preform assembly 20 from which the container

assembly 120 is blow-molded. Accordingly, such securement details will not be repeated for this embodiment.

In FIG. 1, the preform 22 includes a closed lower end 26 and extends upwardly therefrom in the form of a body 28 that terminates in a cylindrical neck 30 that is integrally molded with the body 26. (Directional words such as "upper" and "lower" are employed by way of description and not limitation with respect to the upright orientation of the preform assemblies and components illustrated in the drawings. Directional words such as "radial" and "circumferential" are employed by way of description and not limitation with respect to the axis of the preform neck or finish ring as appropriate.) As also shown in FIGS. 3-5, the finish ring 24 is circumferentially continuous and includes an annular cylindrical wall 32 having one or more external threads or thread segments 34. In the preferred embodiment illustrated in the drawings, a circumferential bead 36 extends around the outer surface of the wall 32 beneath the threads 34 for cooperating with a tamper-indicating mechanism on a closure (not shown) to be secured to the finish portion of the final container. A capping or support flange 38 extends radially outwardly from the lower end of the wall 32, giving the finish ring 24 a generally L-shaped lateral cross section in the illustrated embodiments of the invention. As best shown in FIG. 5, the finish ring 24 includes a cylindrical internal surface 40 and a tapered internal surface 42 extending between top and bottom ends 44, 46. Annular grooves 48 are provided in the tapered internal surface 42, as will be further described in reference to FIGS. 6A-8 below.

Referring now in general to FIGS. 6A-8, there is illustrated a compression molding apparatus 50 for use in accordance with an exemplary method of the present invention. In FIG. 6A, the apparatus 50 includes a core pin 52 positioned above a compression mold 54. The compression

mold 54 includes a closed bottom end 56, a body portion 58, and a partial finish portion 60 that together define a mold cavity 62. The apparatus 50 occupies an open position in FIG. 6A, in which a charge of preform material 64 is introduced into the compression mold cavity 62 and the pre-made finish ring 24 is placed on to the compression core pin 52, as shown. The charge 64 is soft or molten, and thereby conforms to and fills the lower end of the mold cavity 62. The core pin 52, with the finish ring 24 mounted thereto, and the mold 54 are positioned in vertical alignment.

As shown in FIG. 6B, the core pin 52 and finish ring 24 are then moved into the mold 54 to compression overmold the charge 64 partially within the finish ring 24. The term "overmold" is a term of art and, as used herein, means to mold one component from a soft or molten state to another component in a solid or finished state. The molten preform material charge 64 flows in an upward or forward direction between the core pin 52 and mold 54. As a result, the preform 22 is formed including the closed bottom end 26, the body 28 and the neck 30. More significantly, however, the preform assembly 20 is formed from the overmolding of the preform 22 to the finish ring 24. Thereafter, and as shown in FIG. 7, the core pin 52 is retracted with the preform assembly 20, including the preform 22 and finish ring 24, mounted thereto.

As shown in FIG. 8, the preform assembly 20 includes the preform 22 compression molded partially within a portion of the finish ring 24. More specifically, the neck 30 of the preform 22 includes an upper portion 66 having annular projections 68 that extend into the annular grooves 48 of the finish ring 24 so as to positively radially interlock or interengage the finish ring 24 to the preform 22. The annular grooves 48 in the finish ring 24 can also be referred to as radial recesses or radial interengagement features. The radial interengagement between the preform 22 and finish ring 24 provides positive resistance to any axially applied force tending to separate the components

22, 24. The preform 22 also includes a tapered or conical external surface 70 that corresponds to the tapered or conical internal surface 42 of the finish ring 24. The tapered internal surface 42 of the finish ring 24 is greater in diameter than the corresponding portion of the core pin 52. Accordingly, a small gap 72 is provided between the core pin 52, tapered internal surface 42 of the finish ring 24, and a leading edge 74 of the preform 22. In terms of the preform assembly 20, the gap 72 is provided between a transition point 76 of the finish ring 24 and the forward edge 74 of the preform 22, wherein the transition point 76 is defined by the intersection of the cylindrical or straight internal surface 40 and the tapered internal surface 42. The gap 72 is intentionally provided to accommodate within-tolerance variation of the size, volume or weight of the molten preform charge. In other words, at least some gap 72 should always be present under maximum material conditions of both the preform 22 and the finish ring 24, to ensure a proper fit therebetween without any distortion due to overpacking of the preform material into the finish ring 24. The term "overpack" is a term of art and, as used herein, refers to a condition where an excessive amount of molten polymer is compression molded and tends to lead to difficulties in ejecting the finished formed part or parts from the compression molding apparatus. Overpacking also tends to lead to warpage of, and residual stress within, the finished part or parts.

With one or more of the embodiments described above, the present invention provides a number of advantages. The present invention facilitates production of preform assemblies and container assemblies wherein a finish ring is composed of a material different from that of a preform or container to which the finish ring is radially interengaged. Likewise, the present invention facilitates application of finish rings of various sizes and/or materials, to a common size preform and/or container. Moreover, the present invention enables a decrease in the cycle time

required to produce a preform because the constraint of the process – forming the neck finish portion – can be subordinated to a separate, parallel production process for producing just finish rings. In the same vein, the present invention enables a reduction in the piece price of each preform because the mold tooling can be simplified, and reduced in cost, to omit the complex thread split features typically required for the threaded finish portion of the preform.

There have thus been described preform assemblies for blow molding plastic container assemblies, plastic container assemblies blow molded from such preform assemblies, and methods of making such preform assemblies and container assemblies that fully satisfy all of the objects and aims previously set forth. The present invention has been disclosed in conjunction with presently preferred embodiments thereof, and a number of modifications and variations have been discussed. Other modifications and variations will readily suggest themselves to persons of ordinary skill in the art in view of the foregoing description. Indeed, the invention is intended to embrace all modifications and variations as fall within the spirit and broad scope of the appended claims.